being laid in a heap, are covered with other elixed or drained Aſhes, the better to keep them warm; which is reiterated, as long as they make *Brimſtone*.

To make *Coperas* or *Vitriol*, they take a quantity of the ſaid Aſhes, and throwing them into a ſquare planked pit in the Earth, ſome four foot deep, and eight foot ſquare, they cover the ſame with ordinary water, and let it lye twenty four hours, or untill an Egge will ſwim upon the liquor, which is a ſign, that it is ſtrong enough. When they will boyl this, they let it run through Pipes into the Kettles, adding to it half as much Mother-water, which is that water, that remains after boyling of the hardned *Coperas*. The Kettles are made of Lead, 4 ½ foot high, 6 foot long, and 3 foot broad, ſtanding upon thick Iron Barrs or Grates. In theſe the Liquor is boyled with a ſtrong Coal-fire, twenty four hours or more, according to the ſtrength or weakneſs of the Lee or Water. When it is come to a juſt conſiſtence, the fire is taken away, and the boyled liquor ſuffered to cool ſomewhat, and then it is tapp'd out of the ſaid Kettles, through holes beneath in the ſides of them, and conveyed through wooden Conduits into ſeveral Receptacles, three foot deep and four foot long (made and ranged not unlike our Tan-pits) where it remains fourteen or fifteen dayes, or ſo long till the *Coperas* ſeparate it ſelf from the water, and becomes icy and hard. The remaining water is the above-mentioned Mother-water; and the elixed or drained Aſhes are the Dreggs, or *Caput mortuum*, which the Lee, whereof the *Vitriol* is made, leaves behind it in the planked Pitts.

A further Account of Mr. Boyle's *Experimental* Hiſtory of Cold.

In the firſt Papers of theſe *Philoſophical Tranſactions*, ſome promiſe was made of a *fuller* account, to be given by the next, of the *Experimental Hiſtory of Cold*, compoſed by the Honourable Mr. *Robert Boyle*; it being then ſuppoſed, that this *Hiſtory* would have been altogether printed off at the time of publiſhing the *Second* Papers

Papers of theſe *Tranſactions*; but the Preſs, employed upon this Treatiſe, having been retarded ſomewhat longer than was gheſſed, the ſaid promiſe could not be performed before this time: wherein it now concerns the inquiring World to take notice, that this ſubject, as it hath hitherto bin almoſt totally neglected, ſo it is now, by this Exceellent Author, in ſuch a manner handled, and improved by near *Two hundred* choice *Experiments* and *Obſervations*, that certainly the *Curious* and *Intelligent* Reader will in the peruſal thereof find cauſe to admire both the Fertility of a Subject, ſeemingly ſo barren, and the Author's Abilities of improving the ſame to ſo high a Degree.

But to take a ſhort view of ſome of the particulars of this *Hiſtory*, and thereby to give occaſion to *Philoſophical* men, to take this Subject more into their conſideration, than hitherto hath been done; the Ingenious Readers will here ſee,

1, That not only all ſorts of *Acid* and *Alcalizate* Salts, and Spirits, even Spirit of Wine; but alſo Sugar, and Sugar of Lead mixed with Snow, are capable of freezing other Bodies, and upon what account they are ſo.

2, That among the Subſtances capable of being frozen, there are not only all groſs ſorts of Saline Bodies, but ſuch alſo as are freed from their groſſer parts, not excepting Spirit of Urine, the *Lxivium* of Pot-aſhes, nor Oyl of Tartar, *per deliquium*, it ſelf.

3, That many very ſpirituous liquors, freed from their aqueous parts, cannot be brought to freeze, neither naturally, nor artificially: And here is occaſionally mentioned a way of keeping *Moats* unpaſſable in very cold Countries, recorded by *Olaus Magnus*.

4, What are the wayes proper to eſtimate the greater or leſſer Coldneſs of Bodies; and by what means we can meaſure the intenſneſs of Cold produced by Art, beyond that, which Nature needs to employ for the freezing of Water; as alſo, in what proportion water of a moderate degree of Coldneſs will be

be made to *ſhrink* by Snow and Salt, before it begin by Congelation to *expand* it ſelf; and then, how to meaſure by the differing Weight and Denſity of the ſame portion of Water, what change was produced in it, betwixt the hotteſt time of Summer, and firſt glaciating degree of Cold, and then the higheſt, which our Author could produce by *Art*: Where an Inquiry is annex'd, whether the making of theſe kind of Tryals with the waters of the particular Rivers and Seas, men are to ſail on, may afford any uſeful eſtimate, whether or not, and how much, ſhips may on thoſe waters be ſafely loaden more in Winter, than in Summer. To which is added the way of making exact Diſcoveries of the differing degrees of Coldneſs in differing Regions, by ſuch Thermometers, as are not ſubject to the alterations of the *Atmoſphere's* gravitation, nor to be frozen.

5. Whether in Cold, the diffuſion from Cold Bodies be made more ſtrongly downwards, contrary to that of Hot Bodies: Where is delivered a way of freezing Liquors without danger of breaking the Veſſel, by making them begin to freeze at the bottom, not the top.

6. Whether that Tradition be true, that if frozen Apples or Eggs be thaw'd neer the Fire, they will be thereby ſpoil'd, but if immerſed in cold water, the Internal Cold will be drawn out, as is ſuppoſed, by the External Cold; and the frozen Bodies will be harmleſly thawed? *Item*, Whether Iron, or other Metals, Glaſs, Stone, Cheeſe, *&c.* expos'd to the freezing Air, or kept in Snow or Salt, upon the immerſing them in Water will produce any Ice? *Item*, What uſe may be made of what happens in the different waies of thawing Eggs and Apples, by applying the Obſervation to other Bodies, and even to Men, dangerouſly nipp'd by exceſſive Cold. Where is added not only a memorable Relation, how the whole Body of a Man was ſucceſsfully thawed and caſed all over with Ice, by being handled, as frozen Eggs and Apples are; but alſo the Luciferouſneſs of ſuch Experiments as theſe: and likewiſe, what the effects of Cold may be, as to the Conſervation or Deſtruction of the Textures of Bodies: and in particular, how Meat and Drink may

may be kept good, in very Cold Countries, by keeping it under Water, without glaciation? as alſo, how in extreme Cold Countries, the Bodies of Dead Men and other Animals may be preſerved very many years entire and unputrefied? And yet, how ſuch Bodies, when unfrozen, will appear quite vitiated by the exceſſive Cold? Where it is further inquired into, whether ſome Plants, and other Medicinal things, that have ſpecifique Vertues, will looſe them by being throughly congealed and (ſeveral wayes) thawed? And alſo, whether frozen and thawed Harts-horn will yield the ſame quantity and ſtrength of Salt and ſaline Spirit, as when unfrozen? *Item*, Whether the *Electrical* faculty of *Amber*, and the *Attractive* or *Directive* Virtue of *Loadſtones* will be either impaired, or any wayes altered by intenſe Cold? This Head is concluded by ſome conſiderable remarks touching the operation of Cold upon Bones, Steel, Braſs, Wood, Bricks.

7, What Bodies are expanded by being frozen, and how that expanſion is evinced? And whether it is cauſed by the intruſion of Air? As alſo, whether, what is contained in icy bubbles, is true and Springy Air, or not.

8, What Bodies they are, that are contracted by Cold; and how that Contraction is evinced? Where 'tis inquired, whether *Chymical Oyles* will, by Congelation, be, like expreſſed Oyles, contracted, or, like aqueous Liquors, expanded?

9, What are the wayes of *Meaſuring* the *Quantity* of the Expanſion and Contraction of Liquors by Cold? And how the Au hor's account of this matter agrees with what Navigators into cold Climats, mention from experience, touching pieces of Ice as high as the Maſts of their Ships, and yet the Depth of theſe pieces ſeems not at all anſwerable to what it may be ſuppoſed to be.

10, How ſtrong the Expanſion of freezing water is? Where are enumerated the ſeveral ſorts of Veſſels, which being filled

with water, and expoſed to the cold Air, do burſt; and where alſo the weight is expreſſed, that will be removed by the expanſive force of Freezing? Whereunto an Inquiry is ſubjoined, whence the prodigious force, obſerved in water, expanded by Glaciation, ſhould proceed? And whether this *Phænomenon* may be ſolved, either by the *Carteſian*, or *Epicurean* Hypotheſis?

11. What is the *Sphere of Activity* of Cold, or the Space, to whoſe extremities every way the Action of a cold Body is able to reach: where the difficulty of determining theſe limits, together with the cauſes thereof, being with much circumſpection mentioned, it is obſerved, that the *Sphere of Activity* of Cold is exceeding narrow, not onely in compariſon of that of Heat in Fire, but in compariſon of, as it were, the *Atmoſphere* of many odorous Bodies; and even in compariſon of the *Sphere of Activity* of the more vigorous Loadſtones, inſomuch, that the Author hath doubted, whether the Senſe could diſcern a Cold Body, otherwiſe then by immediate Contract. Where ſeveral Experiments are delivered for the examining of this matter, together with a curious relation of the way uſed in *Perſia*, though a very hot Climate, to furniſh their *Conſervatories* with ſolid pieces of Ice of a conſiderable thickneſs: To which is added an Obſervation, how far in Earth and Water the Froſt will pierce downwards, and upon what accounts the deepneſs of the Froſt may vary. After which, the care is inculcated, that muſt be had, in examining whether Cold may be diffuſed through all *Mediums* indefinitly, not to make the Trials with *Mediums* of two great thickneſs: where it is made to appear, that Cold is able to operate through Metalline Veſſels, which is confirmed by a very pretty Experiment of making *Ivy Cups* to drink in; whereof the way is accurately ſet down. Then are related the Trials, whether, or how, Cold will be diffuſed through a *Medium*, that *ſome* would think a *Vacuum*, and which to *others* would ſeem much leſs diſpoſed to aſſiſt the diffuſion of Cold, than Common Air it ſelf. After which follows a curious Experiment, ſhewing whether a Cold Body can operate through

a *Medium* actually hot, and having its heat continually renewed by a fountain of heat.

12, How to eſtimate the ſolidity of the Body of Ice, or how ſtrong is the mutual adheſion of its parts? and whether differing Degrees of Cold may not vary the Degree of the compactneſs of Ice. And our Author having proceeded as far as he was able towards the bringing the ſtrength of Ice to ſome Eſtimate by ſeveral experiments, he communicateth the information, he could get about this matter among the Deſcriptions that are given us of Cold Regions: And then he relateth out of Sea-mens *Journals*, their Obſervations touching the inſipidneſs of reſolved Ice made of Sea-water; and the prodigious bigneſs of it, extending even to the height of two hundred and fourty Foot above water, and the length of above eight Leagues. To which he adds ſome promiſcuous but very notable Obſervations concerning Ice, not ſo readily reducible to the foregoing Heads: *videlicet*, Of the blew Color of Rocky pieces of Ice; and the horrid noiſe made by the breaking of Ice, like that of Thunder and Earthquakes, together with a Conſideration of the Cauſe, whence thoſe loud Ruptures may proceed.

13, How Ice and Snow may be made to laſt long; and what Liquor diſſolves Ice ſooner than others, and in what proportion of quickneſs the ſolutions in the ſeveral Liquors are made, where occaſion is offered to the Author, to examine, whether Motion will impart a heat to Ice? After which, he relates an Experiment of *Heating* a *Cold* Liquor with Ice, made by himſelf in the preſence of a Great and Learned Nobleman, and his Lady, who found the Glaſs wherein the Liquor was, ſo hot that they could not endure to hold it in their Hands. Next, it is examined, whether the effects of Cold do continually depend upon the actual preſence and influence of the manifeſt Efficient Cauſes, as the Light of the Air depends upon the Sun or Fire, or other Luminous Bodies. To this is annexed an Account of the *Italian* way of making *Conſervatories* of Ice and Snow, as the Author had received it from that Ingenious and Polite Gentleman, Maſter *J. Evelyn*.

But

But want of time prohibiting the accompliſhment of the intended account of this Rich Piece: what remains, muſt be referred to the next Occaſion. It ſhall only be intimated for a Concluſion, that the *Author* hath annexed to this *Treatiſe*, an Examen of Maſter *Hobs*'s Doctrine touching *Cold*; wherein the *Grand* Cauſe of *Cold* and its Effects is aſſigned to *Wind*, in ſo much that 'tis affirmed, that almoſt any Ventilation and ſtirring of the Air doth refrigerate.

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